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has seen the petrified stumps and trunks of trees in the Arizona desert and jumps to the conclusion that deserts in general have been steadily invading once forested regions, from remote ages onward. Had he inquired into the recorded facts of geologic history he would have learned that deserts have existed in many parts of the world ever since the earliest periods, wherever the topographic and atmospheric conditions were favorable. It is not probable that our present deserts are more extensive than those of the Permian period, during which the saltiest of salt lakes partially covered the site of Germany.

I think enough has been said to show what kind of pseudo-science is here being foisted upon a trusting public. "Mars as the Abode of Life" is avowedly a popular exposition of a science, not a fantasy. Its author is a highly educated man of distinguished connections and some personal fame. He writes in a vivid, convincing style, with the air of authority in the premises. The average reader naturally believes him, since he can not, without special knowledge of geology and kindred sciences, discern the fallacies. He has a right to think that things asserted as established facts are true, and that things other than facts will be stated with appropriate reservation. This is precisely the same as his right to believe that the maple syrup he buys under that label is not glucose, but is genuine. The misbranding of intellectual products is just as immoral as the misbranding of the products of manufacture. Mr. Lowell can not be censured for advancing avowed theories, however fanciful they are, for it is the privilege of the scientist; nor for making unintentional mistakes in fact, for that is eminently human. But I feel sure that the majority of scientific men will feel just indignation toward one who stamps his theories as facts; says they are proven, when they have almost no supporting data; and declares that certain things are well known, which are not even admitted to consideration by those best qualified to judge. Censure can hardly be too severe upon a man who so unscrupulously deceives the educated public, merely in order to gain a certain notoriety

and a brief, but undeserved, credence for his pet theories.

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SCIENTIFIC BOOKS

L'Europe Préhistorique. Principes d'Archéologie Préhistorique. By SOPHUS MÜLLER. Translation from the Danish, by EMMANUEL PHILIPOT. Paris, J. Lamarre, Editeur. 1907. Pp. 212, text-figures 161, colored plates 3.

There was a time when civilization did not exist. When did it begin to be and whence came it? Sophus Müller believes it was transplanted into Europe from the Orient. The author has endeavored to confine his work to those elements in prehistoric archeology about which authorities are in accord.

Not much space is devoted to the paleolithic period. France is taken as a center and as the region that shows to best advantage the various stages of paleolithic culture. The reindeer epoch is lacking in Italy, as one might expect, although specimens of the Solutrean and Magdalenian types are found there.

The first epoch of the neolithic period in Italy was synchronous with the last epoch of the paleolithic period in France; the culture of middle Europe being only the periphery of a civilization more advanced in the south.

According to Müller there was in central Europe only one great period of cold after the warm climate of the Chellean epoch when man appeared for the first time. The temperature dropped during the Solutrean and became very cold in the Magdalenian, to grow milder again until the present time. He also believes the paleolithic period to be much shorter than the time ascribed to it by many geologists, notably Penck.

A chapter is devoted to the changes that came with the appearance of the neolithic period in central and northern Europe, especially the differences in the fauna and the similarities among the artifacts. The importance of Piette's discoveries of a transitional industry in the cavern of Mas d'Aziil

(Ariège) is noted, as well as similar finds in northern Germany, Russia and Denmark. The north was colonized at a later epoch than were western and southern Europe, Müller placing the date at about 6000 years B.C.

The appearance of the stone ax, chipped but not polished, is what marks the beginning of the neolithic period. It was in the kitchen middens of Denmark that the two principal forms of this ax were first recognized. These shell heaps seem to have been the dwelling places of the people, as numerous hearths are found in them. Here implements were made and repaired. Sherds of a coarse pottery without ornament are also found. Two types have been determined: large jars with pointed bottom, and shallow bowls. The dog was already domesticated, but had evidently been brought to the Danish peninsula from southeastern Europe. The stone axes of the kitchen midden types are found not only to the eastward as far as Russia, but also in southern England, over France, where it characterizes the so-called Campignian epoch, and in Italy. This is also the epoch of small arrow points with transverse edge.

But it would be an error to suppose that the civilization of the north and of the south had the same aspect. New elements were replacing the old in Italy long before they reached Denmark. On the other hand, the tardiness on the part of the latter country was an important factor in the splendid development of its local neolithic industry.

With the second stage of the neolithic period appeared the polished stone ax, a much better tool than its predecessor. It ushered in a period of general industrial development that continued uninterrupted for about 2,000 years. In the Balkan peninsula, Greece, Italy and Spain, none of the polished stone axes are of flint, although this material was used in the manufacture of other tools and arms. A striking example of this is afforded by the prehistoric station of Butmir near Sarajevo, Bosnia, where about six thousand axes and chisels were found and not one made of flint; although there was plenty of flint in the neighborhood and it was used in other forms. North of the Alps, on the contrary, polished

flint implements occur with increasing frequency until England and Scandinavia are reached. This state of things is no doubt due to the longer duration of the neolithic period in the north and to the amount of labor required to polish flint.

The art of polishing stone implements evidently originated in the Orient, as did the other characteristic element of the later neolithic, *i. e.*, the geometric ornament on the pottery that replaced the realistic art of the paleolithic. This epoch was preeminently influenced by the domestication of animals. To the dog were added the sheep, the goat, the hog and ox. Agriculture became more and more important. Wheat, barley and millet were all cultivated and all came from the Orient, as did the domestic animals. The people became less and less nomadic in their mode of life. They lived for the most part in villages composed of huts half underground. These followed one general plan—a round or oval excavation covered by a roof of branches and reeds and strengthened by the application of clay. This type of dwelling spread over Europe as far as Scandinavia and persisted for centuries. It was during this epoch that the first burials properly so-called were made. They were similar to present-day burials in that they were simple ditches sunk in the ground and were individual sepultures as opposed to the communal sepultures of the caverns; or of the dolmens of a later period. The dead were placed on the side, with arms sharply flexed at the elbows, bringing the hands to the region of the face; and the legs folded, bringing the knees near the breast. The same mode of burial was practised during the neolithic period of Egypt. Curiously enough, the same method of burial was used by the Indians of southern Connecticut before the advent of the Europeans.

Only 6,000 years is given for both the paleolithic and the neolithic period in Egypt, *i. e.*, from 10000 B.C. to 4000 B.C. For southern Europe the first epoch of the neolithic period is supposed to have begun about 5000 B.C., and the second epoch of the neolithic about 4000 B.C. These epochs began about 1,000 years later, respectively, in Scandinavia.

Copper was employed first in the Orient. It was known in Egypt as early as the first dynasty, about 5000 B.C. But its use was restricted and stone implements, particularly as cutting tools, were very generally employed until 3000 B.C. The Egyptian influence on the pre-Mycenæan civilization is noted and the characteristic stone burial cists of that epoch are described.

The beginning of the proto-Mycenæan epoch is placed at about 2000 B.C. With it appeared pottery of a new and much-improved order. The paste was fine, the modeling excellent and the ornaments in color. This epoch is known in Sicily, southern Italy and Sardinia by the sepulture *a forno*, so named because of its resemblance to an oven. Tombs of this type were communal and placed by preference in the flank of an escarpment. There also existed in these regions the dolmen proper. The two types of communal tomb are genetically related to the pre-Mycenæan stone cist. Strange to say, the dolmens spread to western Europe, Great Britain and Scandinavia, but did not replace in central Europe the ancient custom of individual burials.

The epoch of transition from the neolithic to the bronze age is called the "eneolithic" and corresponds to the Mycenæan. It was preeminently the age of the poniard, the spear and the lance coming later. Properly speaking, there was no eneolithic epoch in Scandinavia, although this epoch had a profound influence on northern civilization. For example, the flat-poled flint ax so characteristic of the north, and which is more recent than the flint ax with pointed pole, seems to have been copied after the copper axes of southern Europe at a time when metal was rare in the north and flint was plentiful. The dolmen also that characterized the eneolithic of the Mediterranean countries was introduced into Scandinavia during the first part of the neolithic period. The flint mines of Sicily and of Belgium are of the same type; but the former were worked by an eneolithic people and the process was borrowed by the races of Belgium before they emerged from a purely neolithic age. Not only flint, but also obsidian remained an article of merchandise well into the

bronze age. Obsidian is easily traceable to its original sources in Italy, Sicily and certain islands of the Ægean sea. The finest example of the diffusion of flint from a single source is that of the Grand-Pressigny (Indre-et-Loire) which is recognized by its color and has been traced not only all over France, but also into neighboring countries.

Müller enumerates the fundamental principles that should guide one in studying the relations of the central to peripheral civilizations as follows:

1. Southern Europe represented the active productive civilizing force, while the countries to the north, being peripheral, played a receptive rôle.

2. The civilization of the south was transmitted only in abridged and modified form; subject in the more remote regions to a further development along entirely new and original lines.

3. Types of tools, weapons, apparel and ornaments may persist with but little change for a considerable lapse of time.

4. Elements which along the Mediterranean belonged to successive periods may become contemporaneous in the peripheral regions.

These principles were understood by the men who founded the science of prehistoric archeology during the last century. Müller believes that Montelius would make the prehistoric epochs of the peripheral region follow too closely those of the center. He also does not agree with Penka that Scandinavia itself was a center, a source of civilization; nor with Reinach, who regards Europe as independent of the Orient.

A chapter is devoted to the closing epoch of the neolithic period in the north, where stone art reached its apogee. The finest examples are the flint poniards that are so common in the dolmens of this epoch and that have their prototype in the bronze age—poniards of southern Europe. No such development of the later neolithic is to be found in the countries bordering on the English Channel, because the development in stone art was cut short by the introduction of metal at an earlier period.

Considerable space is given to the My-

cenæan civilization which reached its zenith about 1500 B.C. It is pointed out that the dwellings of the period were not of a permanent character, while the houses of the dead were built for eternity. "The tombs with cupola of Greece and the giant dolmens of Denmark are derived from the same conceptions of life and death and are fundamentally one and the same thing. Nothing better than these monuments could reveal to us the unity of European civilization, and at the same time nothing shows more clearly the differences between the south and the north during the second millennium B.C."

Iron was known in Greece toward the close of the Mycenæan epoch, but was employed only for small objects. Bronze was the metal in general use. One could therefore speak of this epoch as the bronze age. But Müller prefers Mycenæan for Greece and bronze age for the rest of Europe, where the civilization was much less rich, though derived from the same source, *i. e.*, from the Orient through Greece. The typical weapon of the bronze age was the poniard. The sword came later, not before the close of the period. The fibula made its appearance here and was the point of departure for the development of feminine ornament during the epochs to follow, and after having fallen into disuse for ages has only recently appeared in its original form, but with another name—safety pin.

One remarkable prehistoric phenomenon is the plentitude and decorative richness of the bronze age in Scandinavia and the mediocrity of the same civilization in western Europe. The latter was received indirectly by way of Italy, while the former came directly by way of Orient. In all western Europe from Spain to Great Britain there is not found a single fibula of the bronze-age type. This absence joined with that of the spiral ornamentation is proof that the Occident was farther removed from Greek influences than were the Baltic countries. The Mycenæan culture is supposed to have reached the north by way of the Adriatic, western Hungary and Bavaria.

The lake dwellings form an interesting phase of the prehistoric in Europe. They are grouped about the Alps. Switzerland, southern

Germany, Savoy, northern Italy and Austria (including Croatia and Hungary). The structures were quadrilateral, a fact suggesting Mycenæan influence. At least 200 village sites have been discovered in Switzerland alone since the winter of 1853-4. These belong to different epochs, the later neolithic, bronze and iron ages, respectively. Some in fact were inhabited during successive ages. The purely bronze-age stations are found farther in the water than are the purely neolithic.

Just as curious in their way as the lake dwellings are the terramaras of northern Italy. This is a corruption of "terrarnarna," a name which was given to the low flat hillocks in the valley of the Po from which a fertilizing earth has been extracted since early in the eighteenth century, long before the real significance of the deposits was known. They owed their existence to pile dwellings built on land but protected by water artificially regulated. Over a hundred have been explored thus far. The finest one is at Castione, northwest of Parma. Its present height above the plain is only three meters but the thickness of the deposit is five and a half meters. Three successive villages had stood on the spot, the first two having been destroyed by fire. The terramaras represent preeminently a bronze age culture that came from Greece by the way of southern Italy.

The Dipylon epoch in Greece witnessed the appearance of a special geometric style of decorative art, consisting of straight lines and meanders. This art, developed about 1000 B.C., was not original and spontaneous. Although it consisted of old elements, these were brought together to form a new and harmonious ensemble. The same motives were in use a thousand years later in Scandinavia. Figurines of the horse characterize this epoch. Gold and silver were scarce. The use of iron became general.

The Dipylon epoch gave Italy its first iron age, which in its turn became the point of departure for a new period of civilization in the other countries of Europe. This period in Etruria was characterized by cinerary urns of coarse paste, made without the use of the

wheel and with incised instead of painted ornaments. The motives, however, recall those of the Dipylon epoch in Greece—zig-zags, meanders, etc. All sorts of small objects were placed with the dead—among others the bronze razor with a single edge in place of the earlier two-edged razor; also, a new type of fibula with highly arched body instead of the Mycenæan type. There appeared at this time a sword with a hilt terminated by two branches—a type destined to play an important rôle north of the Alps as far as Scandinavia.

The first iron age in Italy is generally called the first Villanova epoch (1000 B.C.). It is also called the epoch of well-shaped tombs, *tomba a pozzo*. The second epoch of Villanova reveals an increasing Greek influence accompanying a local original development. Incineration gave place by degrees to interment; and ancient linear ornament was succeeded by life forms repeated in series to form zones, recalling the Dipylon style. Much progress was shown in the construction of tombs, as witness the celebrated tomb of Regulini-Galassi discovered in 1836 at Cervetri. After the fall of Carthage, Greek influence practically superseded the oriental in Etruria. After having given to Tuscany its money, alphabet, architecture, industry and divinities, Hellenic civilization crossed the Apennines and invaded the Po Valley. The best evidence of this is afforded by the Certosa cemetery at Bologna.

The first iron age of central Europe had its sources in the recent Villanovan civilization of northern Italy. It is commonly called the Hallstatt epoch, from the village of Hallstatt in Austria near which was discovered a prehistoric cemetery representing the entire period. But the Hallstatt civilization was as restricted in area as it was distinctive in character. This limited zone became a center of civilization for the contiguous countries, which for the most part were still in the bronze age. This was particularly true of Hungary, Scandinavia and Switzerland.

The second iron age, or epoch of la Tène, dating from about 500 B.C., is better known than the Hallstatt epoch. We know that

toward the close of the latter period there arose in what now corresponds to France and Germany a special civilization which reached its zenith during the fourth century B.C. There was created at the commencement of the period a decorative Celtic style of such value and refinement as to be considered not only original, but also national. Yet in the last analysis these motives are derived from the palmette and classic volute. The Celtic period may be divided into two epochs: an older corresponding to the Gallic domination and a younger represented by the discoveries at la Tène on Lake Neuchâtel. The two halves of the Celtic period were of unequal merit, the latter representing an epoch of decadence. The period left its traces in Scandinavia, some of the specimens being of excellent workmanship. In both Scandinavia and Great Britain the bronze age was prolonged into the epoch of la Tène.

The movement of civilization in western Europe during the epoch of la Tène had its counterpart in the region to the north of the Black Sea, where the cemeteries of the time have furnished such a surprising quantity of beautiful objects of art, particularly gold ornaments. This rich period may be placed between the fifth and the second centuries B.C. As one penetrates farther into the interior of Russia the indigenous Scythian art makes itself felt more and more. It is characterized by animal figurines or simply the heads of animals used ornamentally. A good part of Scythian art and industry came direct from Asia and eventually spread its influence over northern Russia and into Hungary.

Rarely has a victory had for the history of civilization such vast consequences as the victory of Alesia, 52 B.C., by which Cæsar vanquished the last armies of Gaul. After this the frontier of the prehistoric domain retreated rapidly toward the north. The Germanic world came into direct contact for the first time with the classic civilization of the south.

During the epoch of invasions there was a marked development of provincial industry. The Roman bronze vases, for example, were no longer made in the south for exportation,

but in the region of the Rhine and in France. The sixteen beautiful pails from the cemetery of Hemmoor near Hanover are examples. One often finds Roman motives in use, but under forms scarcely recognizable. Among the most remarkable specimens of this kind belonging to the epoch of invasions must be classed the celebrated golden horns of Gallehus in Schleswig. To this period also belongs the Roman silver service found at Hildesheim.

Differences are pointed out between the recent Celtic civilization of Germany and that of Great Britain and Ireland. At the time the Romans gained a foothold in England local Celtic art had reached a high stage of originality and development. Celtic elements were even borrowed by the Romans, whose political domination over the land did not exercise any marked influence on the national art, which continued without interruption particularly in Scotland and Ireland, and which culminated in the heroic and legendary Celtic period of the first 500 years A.D.

The last two chapters are devoted to the closing epochs of prehistoric times in Scandinavia (500 to 1000 A.D.), and to Finland and the Slavic countries.

Müller, who is director of the National Museum of Danish Antiquities, has been known for years as a gifted writer on northern archeology. The present volume maintains the high standard the author set for himself in earlier works. Each chapter is accompanied by a selected list of references. One misses, however, an index which is all but indispensable in a work so important as this. The next general work on prehistoric Europe will in all probability devote more space to the contributions of such men as Rutot and Penck; those of the former on pre-Chellean industry and those of the latter on the antiquity of man from the standpoint of glacial geology.

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Grundriss der Kristallographie für Studierende und zum Selbstunterricht. Von Dr. GOTTLOB LINCK. Zweite umgearbeitete Auf-

lage. Pp. 254, 604 figures, 3 colored plates. Jena, G. Fischer. 1908.

Since the appearance of the first edition of this little text-book of crystallography twelve years ago it has remained the most satisfactory elementary treatise on the subject in any language. Unlike most text-books in the same field, it discusses crystallography in all its phases. Crystals are treated as bodies possessing certain well-defined properties in consequence of their structure, rather than merely as bodies characterized by distinct forms.

Starting with a brief statement of the difference between typical fluids and typical solids, the author develops the usual conception with reference to the growth of crystals, and follows this with descriptions of different kinds of crystal aggregates, a discussion of the symmetry of crystal planes, and statements of their simplest zone relations. The 32 classes of crystal forms are then treated in detail in 92 pages. In the first edition this discussion occupied 116 pages. The reduction is due to the omission from the new edition of some unnecessary explanations of figures, to the condensation of such explanations as are retained, and to a slight rearrangement in the order of treatment of some features of the subject. Everything essential to the understanding of the principles of geometrical crystallography remains, and in addition there has been introduced a most excellent series of photographs of crystal forms and combinations that will prove a welcome novelty to the student. On the whole, the first half of the revised edition does not differ materially from the corresponding portion of the earlier edition.

It is in the last half of the volume in which the greatest changes are observed. This now occupies 114 pages as against 93 pages in the first edition. The study of the physical properties of crystallized substances has advanced so rapidly in the past decade, and the results of these studies have become of such practical importance in physical and chemical investigations that they merit much more careful consideration than is usually given them in text-books published in the English language. Indeed, there is scant reference to